



DEPARTMENT OF ENVIRONMENTAL AND RADIOLOGICAL HEALTH SCIENCES

RADIOLOGY RESIDENCY PROGRAM

1. INTRODUCTION

The Department of Environmental and Radiological Health Sciences at Colorado State University offers a combined Residency program in Veterinary Diagnostic Imaging, and an optional master's program, with the objective of meeting the eligibility requirements of the American College of Veterinary Radiology to sit for the certifying board examination. The program offers clinical training in all aspects of diagnostic imaging under the guidance of 4-8 board certified faculty radiologists. A total of six to seven residents are typically being trained at any one time (1-2 starting the program each year). The radiology faculty has imaging expertise which encompasses large and small animal radiology, ultrasound, nuclear medicine, computed tomography, and magnetic resonance imaging.

The residency is a three-year program combined with an optional master's degree that typically begins in July. The master's degree is earned in conjunction with the residency by completing a non-thesis graduate program of study. This program consists of 30-36 hours of graduate coursework, completion of a research project, and successfully passing a final oral graduate examination. Results of the research project(s) are to be presented during resident seminars at CSU, presented at the annual ACVR scientific meeting and a manuscript submitted for publication to an appropriate national or international journal.

Residents will also gain teaching experience by presenting at least 3 presentations/seminars, but also more extensively through less formal clinical teaching sessions with veterinary students. A stipend is provided, tuition and associated fees are paid, and two weeks of vacation per year are allowed. The residents/grad students may incur fees for graduation and will be taxed on the employee study privilege benefit, if coursework is elected, which will be their responsibility to pay.

II. Objectives

The residency training program is designed to provide supervised training in diagnostic imaging in an atmosphere conducive to learning clinical diagnostic imaging with an introduction to clinical investigation. The residency is also designed to prepare the trainee for certification by the American College of Veterinary Radiology. The residency is

designed to provide thorough training in small and large animal radiology and ultrasound, computed tomography, and magnetic resonance imaging. More limited training is also provided in nuclear scintigraphy.

III. Training Period

The residency program requires 3 years (36 months) of training in veterinary diagnostic imaging of which at least 30 months is supervised clinical experience. See Appendix B for a schedule of clinical experience.

IV. Direction and Supervision

The program director has a $\geq 50\%$ commitment to the diagnostic imaging service and is involved in clinical instruction to residents as well as resident rounds, journal club, and known case conference. ACVR Diplomates are assigned to diagnostic radiology, ultrasound, nuclear medicine, CT, and MRI services at all times.

V. Faculty

The following faculty are involved in the residency training program.

Residency Director

A. Ohlendorf, DVM, DACVR, MS

Faculty Radiologists

M. Barrett, DVM, Diplomate ACVR, DVM

A. Ohlendorf, DVM, Diplomate ACVR, MS

E. Randall, DVM, Diplomate ACVR, MS

K. Selberg, DVM Diplomate ACVR, MS

Faculty Emeritus

R. Park, DVM, Diplomate ACVR, PhD

S. Kraft, DVM, Diplomate ACVR, PhD

Formal teaching of didactic lectures to professional veterinary students and graduate students are distributed equally among faculty. Radiology resident/graduate research projects are supervised primarily by one selected radiology faculty member, but other radiologists serve on the graduate committee and thus play a supervisory role as well.

Diagnostic imaging faculty share clinical rotations and resident lectures, clinical case rounds, known case conference rounds, and average 50-75% time on clinical duty, 20-35% time teaching and 0-15% time research.

Specialists in Veterinary Teaching Hospital include (as of 9/2021):

American College of Veterinary Radiology	4
American College of Veterinary Internal Medicine	19
American College of Veterinary Theriogenology	5
American College of Veterinary Surgery	17
American College of Veterinary Ophthalmology	2
American College of Veterinary Anesthesiology	6
American Association of Zoological Medicine	2
American College of Veterinary Emergency Critical Care	2
American College of Veterinary Pathology	15

VI. Affiliation Agreement

The residency program has external cooperation with VetCT for training residents, and works with multiple locums on an individual basis.

VII. Facilities (as of 9/2021)

The facilities at the CSU Veterinary Teaching Hospital reflect state-of-the-art diagnostic imaging. The diagnostic imaging department is completely digital with a combined electronic medical record (EMR) system (StringSoft) with integrated Radiology Information System (RIS) and PACS system (iSite Phillips). Diagnostic imaging has the following assigned rooms:

Radiology:

Large Animal	1 Examination rooms
Small Animal	2 Radiology, 1 fluoroscopy examination rooms
Ultrasound	4 Examination rooms (2 small animal general, 1 small animal musculoskeletal, 1 large animal)
CT	2 Examination rooms, 2 control rooms, and 2 equipment rooms
MRI	1 Examination room, 1 control room, 1 reading room and 1 equipment room
Nuclear Medicine	2 rooms diagnostic, 2 wards, 1 radiopharmaceutical lab
I-131 Facility	1 ward, 1 ante-room

Equipment (as of 9/2021):

Small Animal Radiography

800 mA Siemens Multix Top/Vertex Solitaire machine, with four-way float top elevator table, Eklin RapidStart Clinical Digital Radiography System.

Small Animal Radiography

Toshiba KXD-80F, 800 mA, 180 KW, microprocessor-controlled generator, with a tilting and floating table.

An overhead suspended X-ray tube of 150 kV capacity interlocking capability with a fine bucky grid.

Eklin RapidStart Clinical Digital Radiography System.

Small Animal Special Procedure Room

Philips Veradius Neo with Flat Detector.

A C-Arm for fluoroscopy examinations, and digital imaging X-ray tube.

One pressure injector: MedRad Arterion Mark 7

IDI table with floating top

Large Animal Radiography

One overhead ceiling-suspended longitudinal and transverse rail systems to support two telescoping cranes for high powered Vertex X-ray tube and a catapult bucky grid with interlocking capability at set distances and move as a unit or independently.

Universal Canon Digital Radiography System with Cesium Iodide 14x17 wireless active capture panel, and Cesium Iodide 11x14 wireless active capture panel.

High powered ultra high heat capacity Vertex Rad 92 X-ray tube

CPI Indico 100 - 100 kw generator, 800 mA

In addition:

One Minray 80+ port with Eklin Mark III Digital System

One Sound portable generator unit 90+

Ultrasound:

Toshiba Aplio 500 (2)

Toshiba I700 (Equine)

GE Logiq NextGen

Computer Tomography/PET

Philips Gemini TF Big Bore 16 slice PET/CT Scanner

Siemens Somatom Force-Dual source CT 128 slice CT

Siemens Definition AS 64 slice (in the adjacent Translational Medicine Institute building)

Magnetic Resonance

GE 1.5 Tesla 9.0 LX MRI scanner with Multinuclear spectroscopy

Siemens Skyra 3T (in the adjacent Translational Medicine Institute building)

Nuclear Medicine:

SA: Digital Siemens E.Cam; Dual head

LA: Digital Omega Gamma Camera with Mirage Acquisition/Processing Station.

Dicom compliance

VIII. Clinical Resources

The diagnostic imaging service at the CSU VTH sees approximately 10,000 small animal radiology cases and 1,500 large animal radiology examinations per year, including exotic animals and food animal patients. Approximately 3800 ultrasound, 1050 CT, 430 MRI, 160 diagnostic nuclear medicine, and 40 I-131 cases are performed annually. The exotic animal service at the CSU VTH is run by 2 full time clinicians. The Rocky Mountain Raptor program is included in the exotic service. The food animal program includes dairy, beef, and camelids. The equine and small animal clinics at the CSU VTH are staffed by a full complement of surgeons and other medical specialists.

DETAILED PLAN OF TRAINING YEARLY CASELOAD

The average case load and resident case experience are as follows:

	Cases per year
Radiology Small Animal	8,432
Radiology Large Animal	1,345
Ultrasound	3440
Computed Tomography	1297
Magnetic Resonance Imaging	468
Nuclear Medicine (diagnostic)	121
Pet CT	52

Residents will be assigned to radiography, ultrasound, CT/MRI/nuclear medicine, with 2 weeks a year on large animal.

IX. Training Content

Clinical training: Residents have clinical rotations in diagnostic radiology and ancillary imaging areas. Under supervision of an assigned radiologist, residents work with and dictate cases on a daily basis. All reports are reviewed and corrected with the supervising radiologist. Select cases are presented in a rounds format for discussion 4 days a week. Residents also have night and weekend radiology emergency duty during their training. This is shared equally among the residents.

Clinical radiology rounds: Residents will attend radiology rounds 4 mornings a week. Other imaging related discussion sessions are held weekly, alternatively between Known

Case Conference (oral boards prep) and Journal Club. Assignments will be made to residents for participation in Known Case Conferences and Journal Club.

Didactic classes: Residents have the option to enroll in graduate school during the course of their residency program. A plan B (non-thesis) MS degree is offered. Residents pursuing an MS degree are required to meet the minimum credit hour requirement listed below.

Clinical teaching responsibilities: Residents participate in teaching diagnostic imaging to third- and fourth-year veterinary students. Presentation of at least 3 didactic lectures or seminars and participation in continuing education courses and/or anatomy instruction is required.

The following core graduate courses are required for the master’s program:

Course#	Credits	Course Name	Offered
VS 562	3	Applied Data Analysis	Fall
or STAT 307	3	Statistics	
or STAR 511	4	Design and Data Analysis for Researchers I	
ERHS 450	3	Introduction to Radiation Biology	Spring
or ERHS 550	5	Principles of Radiation Biology	Spring
ERHS 712	3	Medical Imaging Physics	Fall, odd years
or ERHS 530	3	Radiological Physics and Dosimetry I	Fall
or ERHS 714	3	Radiation Therapy Physics	Fall, even years
VS 792	1	Seminar	
or ERHS 770	1	Radiation/Cancer Biology-Comparative Oncology	

The following Elective Courses are available including independent study credits in the various modalities. These credits will complete the required 30-36 credits for the MS degree:

Course#	Credits	Course Name	Offered
ERHS 695			
I,J,M-P	Varied	Independent Study	
ERHS 705	4	Advanced Small Animal Diagnostic Imaging	Spring, even years
ERHS 706	4	Advanced Equine Diagnostic Imaging	Spring, odd years
VS 655	3	Echocardiography in Veterinary Medicine	Fall odd years
VS 665E			Every 3 rd year
VS701-704	Varied	Postgraduate Medicine I-IV (requires residency director approval)	
ERHS 721	1-3	Radiation Oncology	

The clinical imaging duties will comprise at least 30 months of the 36-month residency program. Off clinic time (vacation and research/study time) will be approximately distributed as follows: 4 weeks in the first year, 7 weeks in the second year, and 11 weeks in the third year. Off clinic time is spent on clinical investigation projects, board exam preparation, conference attendance etc. The amount of off-clinic time may be changed during the residency at the discretion of the faculty, but not to result in less than 30 months of on-clinic time. Residents are allowed 10 days of vacation per year. Vacation time is considered in your off-clinic time allotment.

X. Research Environment

A prospective or high-quality retrospective research project is strongly encouraged. Possible topics for a project should be discussed with your research advisor. A grant proposal or outline for your project should be developed and presented by the winter/early spring (no later than April/May of your 1st year). Research projects must be reviewed and approved by the resident's advisor +/- graduate committee. A faculty person must be chosen by the resident to be a primary consultant on each investigational project. The results of these investigational projects should be presented in the Graduate Seminar Course, and one project should be presented at the annual ACVR meeting and CVMBS research day. Application for any research money must be made to the appropriate funding agency through the faculty consultant who assumes responsibility for performance of the work.

XI. Education Environment

An education environment is fostered in the training program. The residency program is combined with an optional master's degree. Courses involved and the educational environment is detailed in the description of the training program.

XII. Evaluation

Residents will meet with the Radiology faculty and/or the director of the resident program every 6 months- a formal evaluation will occur in the winter and a more informal in the spring/summer (or more often if needed). At the annual reviews, the following will be discussed:

- Faculty evaluations of the resident's performance to date.
- Progress toward research and publication completion.

If progress towards completion of the master's degree or residency program is deemed unsatisfactory by the radiology faculty, a statement to this effect, including reasons for the unsatisfactory evaluation and suggested methods for correction of deficits will be provided to the resident, the resident's advisor, graduate committee, and to the Department Head. Deficiencies must be corrected within 3 months of the date of the statement of unsatisfactory progress. If deficiencies are not corrected, a recommendation to terminate the resident's program will be made.

Periodic Examinations/Evaluations

Written Mock Board examinations will be available during the course of the residency to assist in preparation for the Preliminary examination in summer of the 3rd year.

Graduate School

Examinations for the completion of the master's program are determined by the Colorado State University Graduate School. Successful completion of the entire combined residency/master's program will fulfill the eligibility for examination by the American College of Veterinary Radiology. However, it must be re-emphasized that completion of anything short of the full three-year program (36 months) will prevent the resident from being credited with having completed an approved program.

XIII. Teaching File

Radiology, ultrasound, CT, MR, and nuclear medicine cases are available for resident training. These teaching files are kept current and updated regularly with material from the known case conference rounds.

There is also a file of articles compiled for reading that are selected to assist knowledge of the ACVR objective list. This is kept up to date by the residents who contribute articles to the file.

XIV. Conferences

The results of the investigational project should be presented at the annual ACVR meeting (or other appropriate meeting) and CVMBS research day. Each resident should attend one ACVR meeting to present their research projects, typically in the 3rd year of the program. Radiology resident rounds are conducted daily. Known case conference and journal club are held weekly (alternating weeks). Clinical seminars are presented weekly for all clinical faculty and residents in the veterinary teaching hospital. Residents may attend 1 resident training conference (nuclear medicine, CT, large animal imaging, etc) during the residency.

XV. Literature Resources

The Colorado State University Clinical Sciences Library is situated in the VTH building. This library is well stocked with books and journals covering both veterinary and human medicine. The radiology department has an updated library located in the radiology reading area with the most commonly needed references. The main library on campus (1 mile north of the VTH) is also available. Internet access is available in the VTH with access to database searches and electronic copies of journal articles. A journal article archive for radiology residents is also available at the VTH. This archive has been compiled and maintained by previous and current radiology residents.